

Status of Top Physics in Wuppertal



Daniel Wicke
(Bergische Universität Wuppertal)



Outline

- Analysis of DØ data
- Studies of Atlas Simulation
- Generator Study

About the Wuppertal Group

Leadership

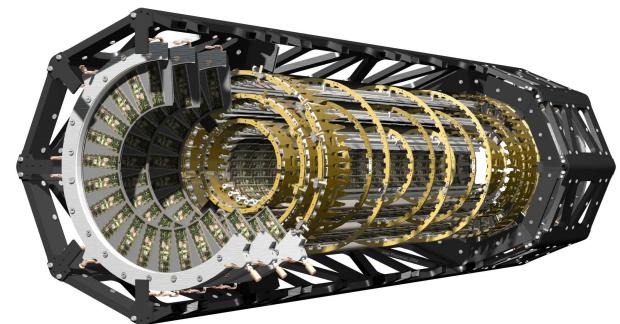
Prof. Peter Mättig, Prof. Christian Zeitnitz

LHC activities: Atlas

Pixel Detector

(*Charlie Glitza, Susanne Kersten*)

Mechanic, Moduleloading,
DCS, Optolink, Integration



Grid Computing

(*Torsten Harenberg, DW*)

Job-Monitoring, D-Grid, Tier-2, Large Scale Prod.



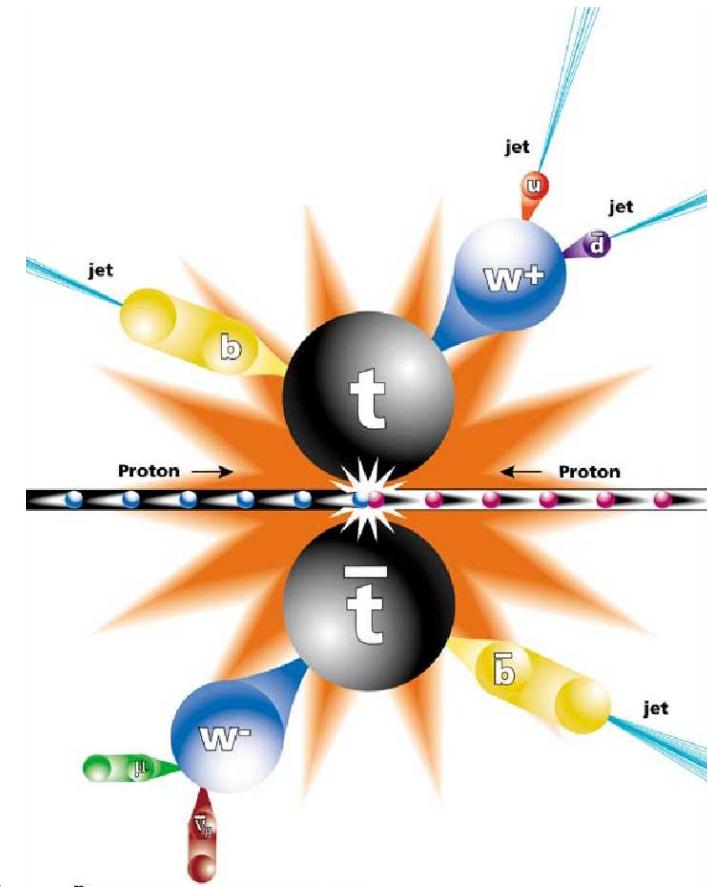
About the Wuppertal Group (2)

LHC activities: Atlas (2)

Physics Analysis

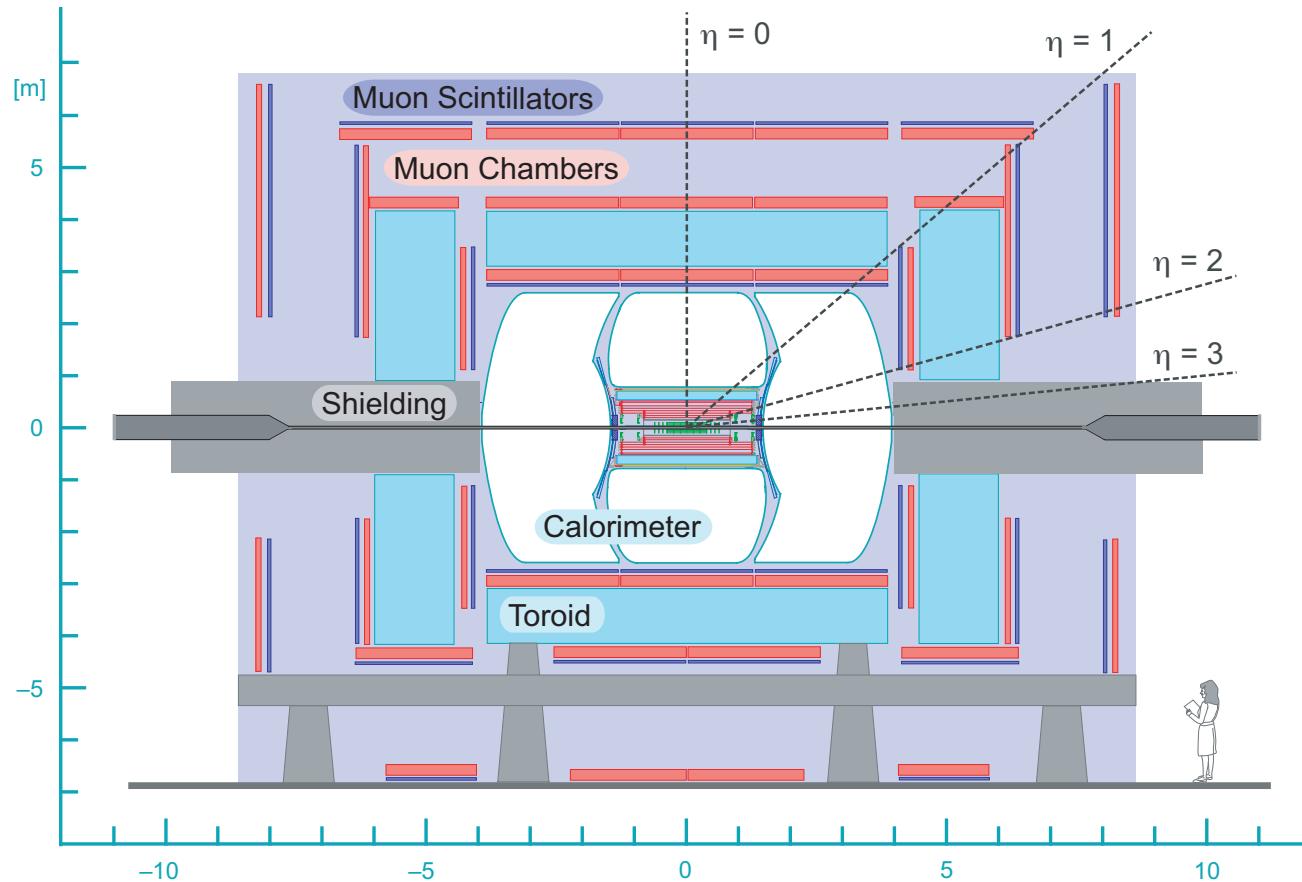
(Klaus Hamacher, DW)

- B-tagging, Vertexing
- Mini Black Holes
- Top Physics
 - Physics analysis of DØ data
 - Preparation of Atlas Tools: B-tagging
 - Studies of simulation within Atlas framework



Grant Gorfine, Hendrik Hoeth, Tatjana Lenz, Yvonne Peters, Sebastian Reuschel, Marisa Sandhoff, Stefan Sandvoss, Anca Siebel, Thorsten Schliephake, Maren Vaupel

Physics analyses of DØ data



Active field over the last years. Preparation for Atlas.

W -Helicity in Top Decays

- SM predicts only lefthanded tops couple to Ws ($V - A$ coupling)
- Visible in angular distributions.

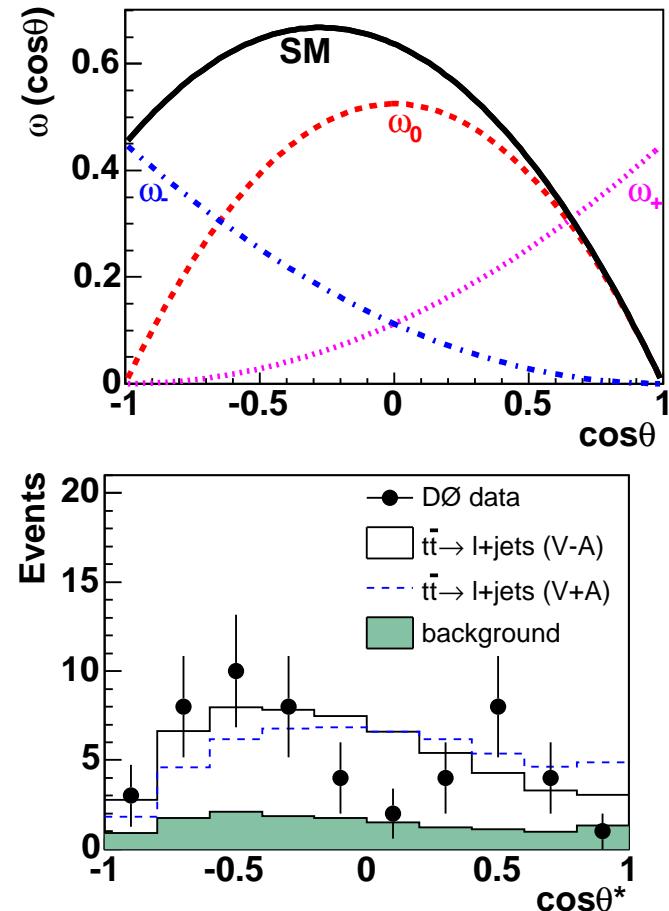
Measured $V + A$ contribution

- Compare $V \pm A$ templates to data.
- Determine likelihood of various $V + A$ admixtures.

DØ Result:

$$f_+ = 0.00 \pm 0.13(\text{stat}) \pm 0.07(\text{syst})$$

Bayesian limit: $f_+ < 0.25 \quad 95\% \text{CL}$



PhD finished. Result is published.

Resonant $t\bar{t}$ production

No resonance production in $t\bar{t}$ expected in SM,
but some models predict bound $t\bar{t}$ -states

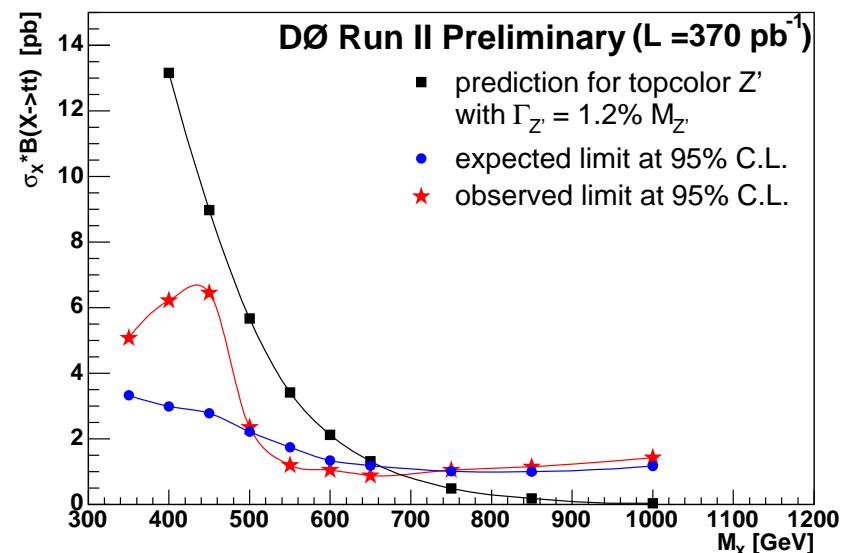
Such a resonance should create
a bump in differential cross-section $\frac{d\sigma}{dm_{t\bar{t}}}$

Assume small width resonance

DØ Result

For benchmark Z' ($\Gamma = 1.2\% m_{Z'}$):

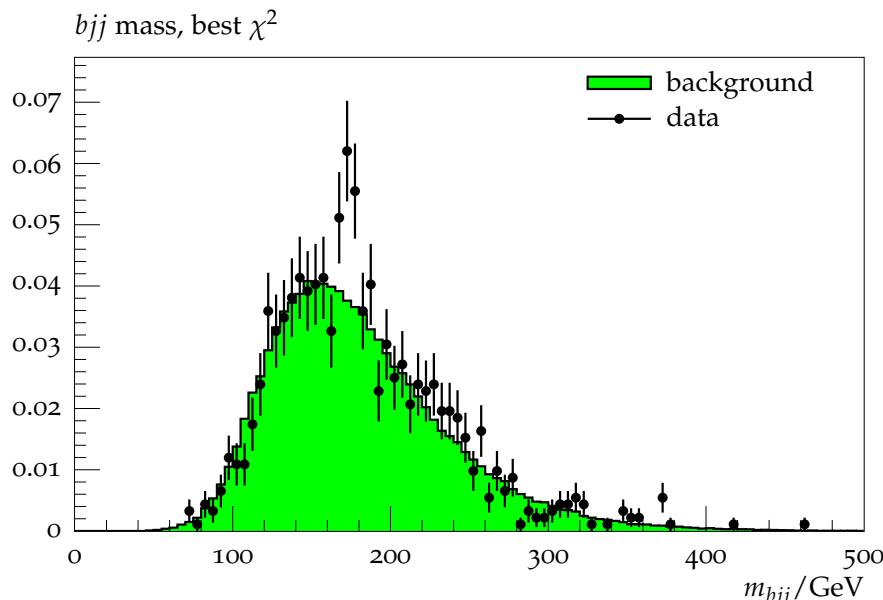
DØ: $m_{Z'} > 680 \text{ GeV} (95\% \text{ CL})$



*Phd completed. Publication with larger dataset in preparation.
To be continued extended by 'new' student.*

Top Mass in Alljets Channel

- Dominating decay channel, but gigantic background.
- Strict selection, Background from data
- Top mass determination with template fits (envisioned).



Selection

- 6 jets of $p_T \geq 45, 45, 25, 25, 15, 15 \text{ GeV}$
- 2 tight b -tags
- Background from 6 jet data no b -tag
With b -jets taken from 4 and 5 jet data.

Ongoing PhD study.

Cross Section and Branching Fraction

Simultaneous measurement of cross section and branching fraction of top pairs.

$$R = B(t \rightarrow Wb)/B(t \rightarrow Wq)$$

from ratio of 0, 1 and double b -tagged top events.

Standard analyses assume $R = 0.998 \simeq 1$.

Previous DØ Result

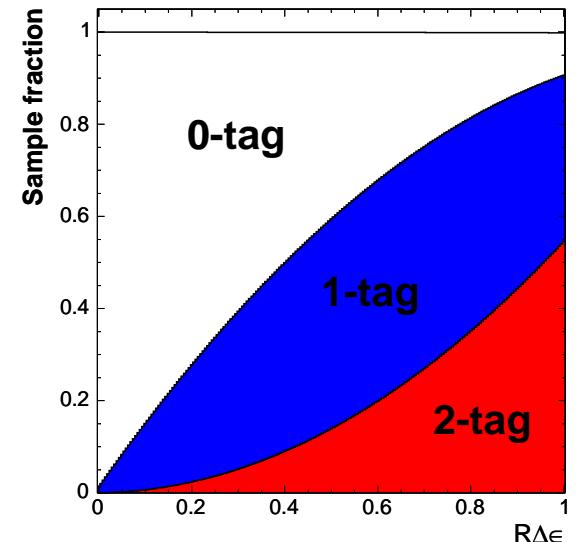
$$R = 1.03^{+0.19}_{-0.17}$$

$R > 0.64$ 95% CL

New study

4 times the statistics.

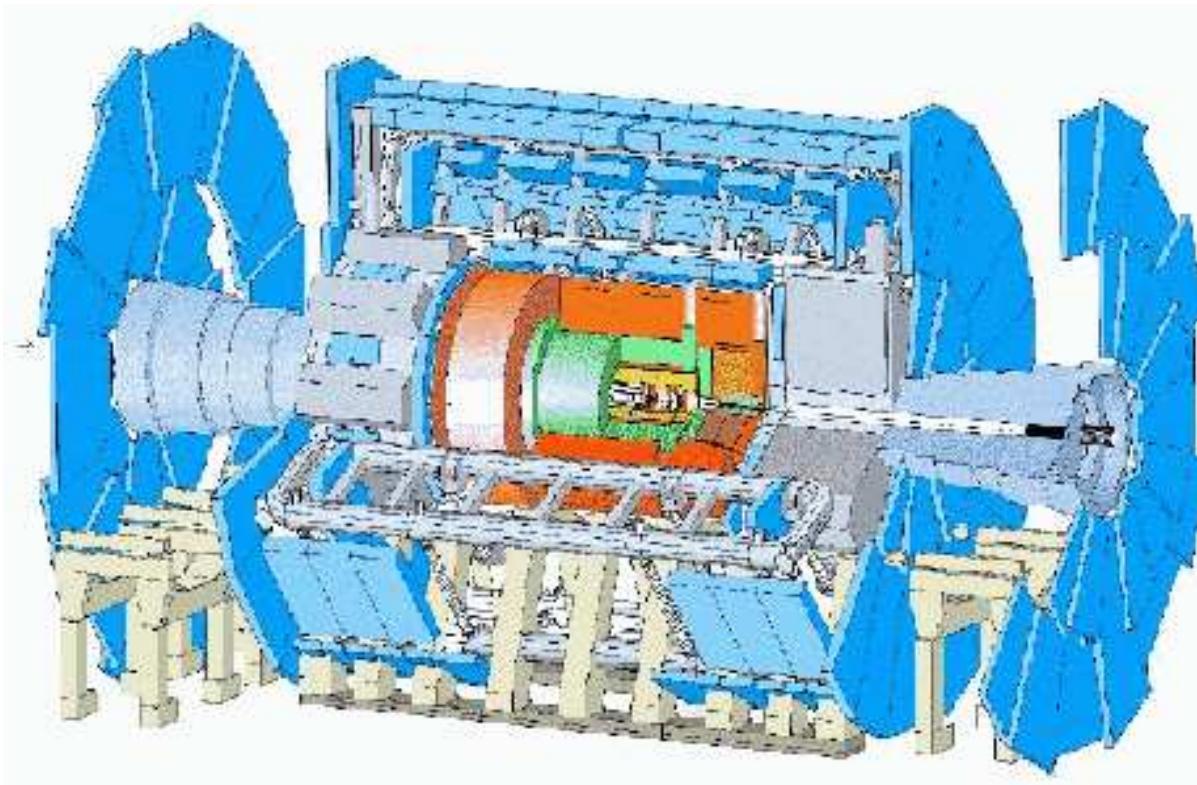
Profit from improved tagging.



(CDF)

PhD started. First results aimed for summer.

Studies of Simulation within Atlas Framework



Preparation of Cross-section Measurement

Influence of Jet Algorithm on Top Analyses

using lepton+ jets channel

Cone 0.4, 0.7 and k_T $D = 0.2\ldots 1.0$

release 11.0.41 dataset 5200

Jet Multiplicity

- Det. jets more consistent with particle jets for k_T

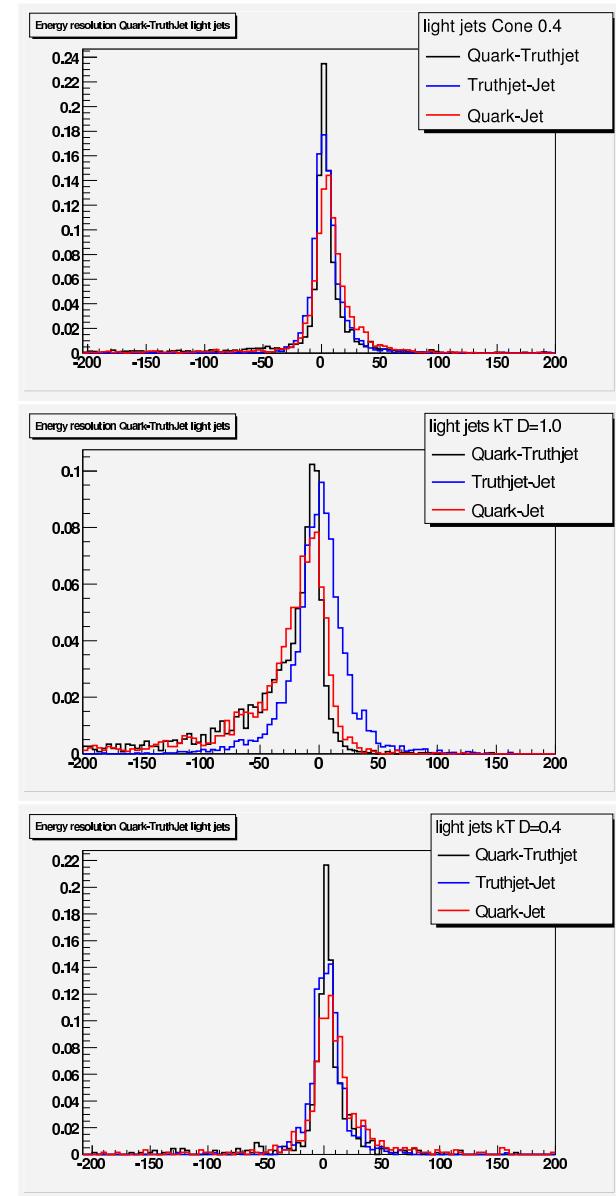
Resolution study

- Jet energy differences between Hard Partons, Particle Level and Detector Level
- Standard k_T ($D = 1.0$) very bad
- Lower D k_T as good as Cone.

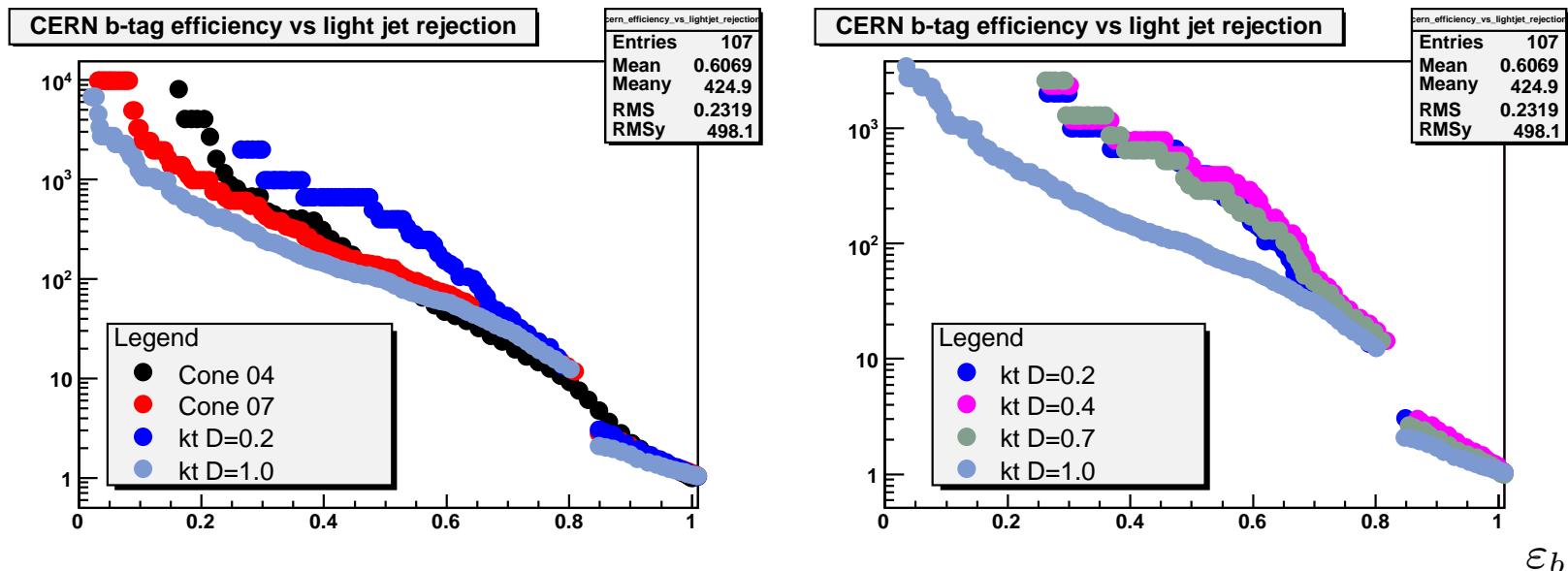
Cone 0.4

k_T 1.0

k_T 0.4



B-Tagging Efficiency



- Checked CERN and Marseille algorithms
- k_T with $D = 1$ horrible. Other D values better than Cone

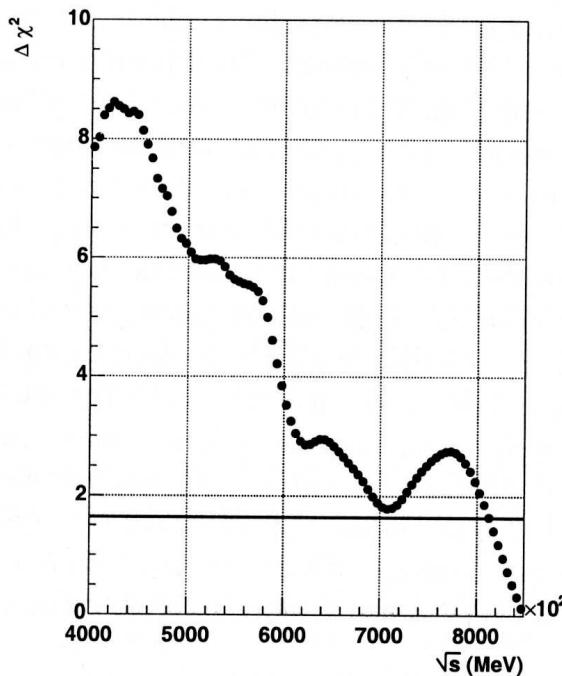
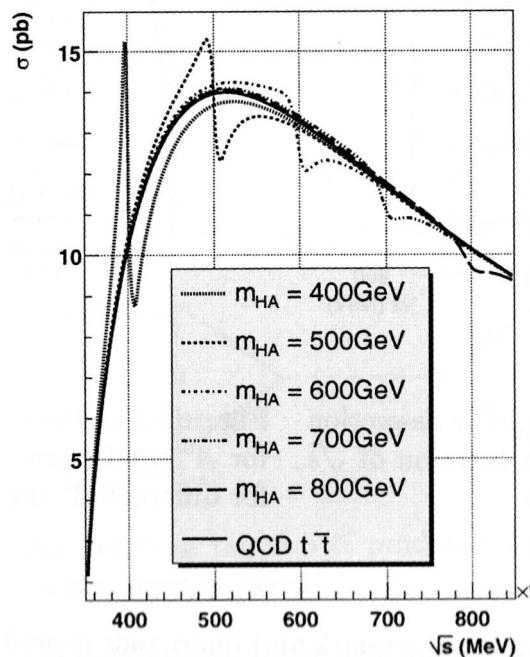
Outlook

Determine selection influence, move to release 12.0.x.

Ongoing Phd thesis. Contribution to CSC note and b-tagging

$M_{t\bar{t}}$ Resonances

In contrast to Tevatron interference with SM production important



- $H/A \rightarrow t\bar{t} \rightarrow 4q + 2b$ with ATLFAST (35 fb^{-1}).
- Reconstruct invariant $t\bar{t}$ mass with constrained fit
- Trigger conditions accounted for

Exclusion of $m_{H/A} \leq 850$ GeV requires LV2 b -Trigger.

PhD thesis finished

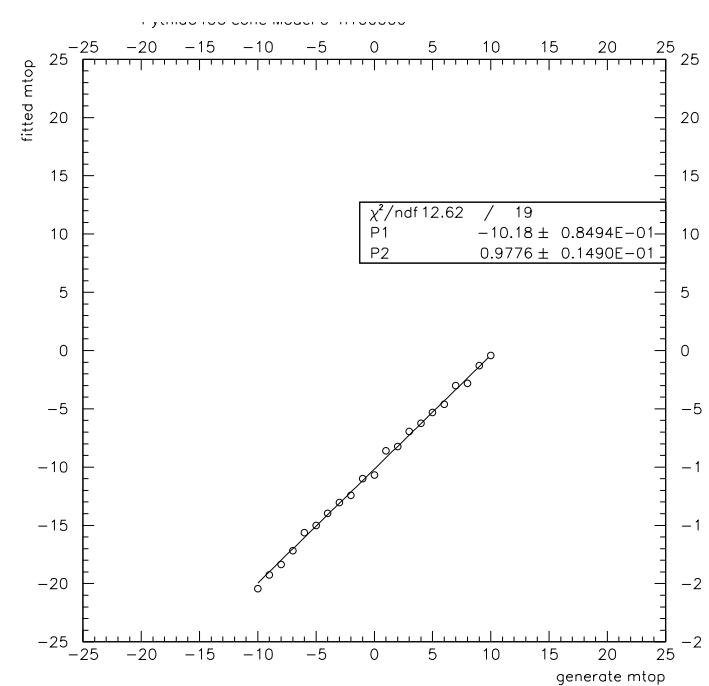
Simulation Study

Influence of Color Reconnection on Top Physics

- Is colour-flow of hard interaction preserved?
- Investigated new models (Pythia) with CR also in hard interaction.
- Models carefully tuned (2 TeV).

Influence on m_t measurement

- Run toy m_t analysis on simulation for many nominal top masses.
- Build “calibration” curve m_t^{gen} vs. m_t^{rec}
- Compare “calibration” curve for diff. models



Influence on m_t measeurement (2)

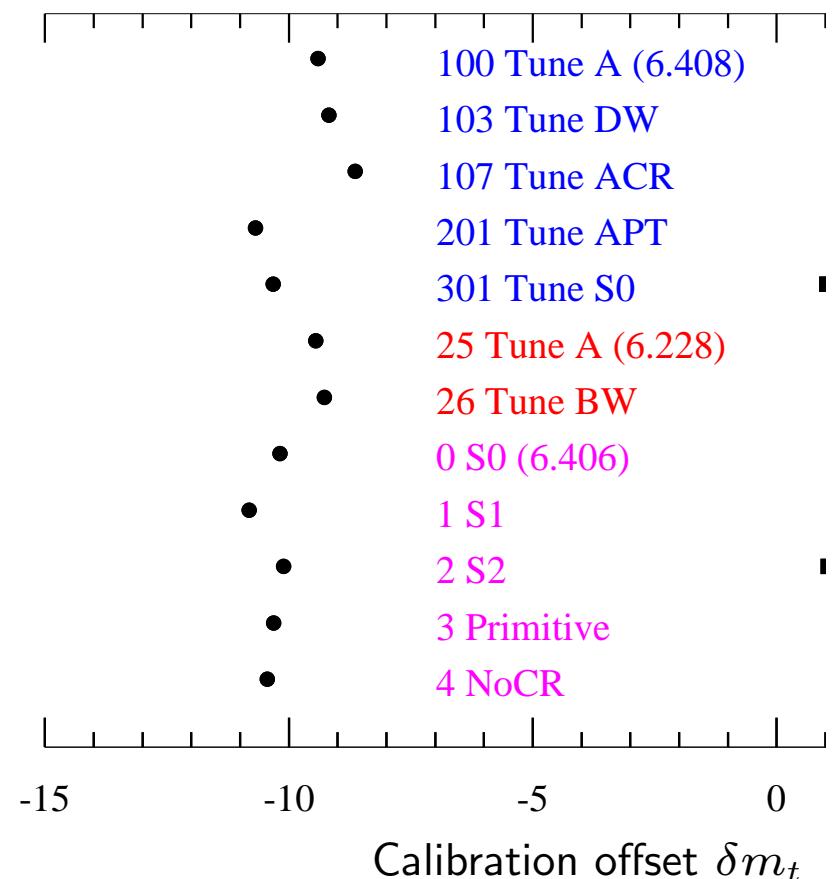
- Different CR/UE models yield different offsets

- Total scatter between models $\mathcal{O}(\pm 1 \text{ GeV})$
- Currently not accounted in uncertainties
- Real mass analyses may have different sensitivity.

- Origin of scatter

- CR and UE $\Delta m_t \sim 0.4 \text{ GeV}$
- Parton Shower $\Delta m_t \sim 0.75 \text{ GeV}$
(mass ordered vs. p_T ordered)

- Further studies neccessary to achieve reduction of m_t uncertainty



Ongoing study with Peter Skands

Summary

Top Physics in Wuppertal

- DØ data analyses continuing
 - W -Helicity, $t\bar{t}$ -Resonances, $\sigma(t\bar{t})$ & R
- Studies of Atlas Simulation
 - Cross-section, Jet algorithm study
 - $t\bar{t}$ -Resonance study
- Generator study
 - Dependence of m_t measurements on CR, UE models and parton showers

